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ABSTRACT

This ERIC Digest discusses the shortage of qualified teachers in mathematics classrooms and analyzes programs to enlarge the pool of mathematics teachers. (KHR)

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Student performance in mathematics has been a matter of national concern for many years, and formal efforts to reform mathematics education has led to the development of national content standards (National Council of Teachers of Mathematics (NCTM),1989) and an update of those standards. (NCTM,2000). U.S. Governors identified mathematics achievement as a national priority by setting a goal that "By the year 2000, United States students will be first in the world in mathematics…achievement" (Report of the National Education Goals Panel, 1989). International comparisons of mathematics achievement, however, indicate that this has not occurred (National Commission on Mathematics and Science Teaching for the 21st Century, 2000).

The good news is that we know how to improve the mathematics performance of students. Research shows that there is a connection between student achievement in mathematics and both the structure of the curriculum and the content of textbooks (Schmidt, et al, 2001), so ongoing development and implementation of content standard should ultimately lead to a desired increase in achievement. Research also indicates a positive relationship between teacher preparation and student achievement (Fetler, 2001; Darling-Hammond, 2000). Indeed, the research on teacher preparation in mathematics and science has led to very specific and practical guidelines for improving teacher education programs (Committee on on Science and Mathematics Teacher Preparation, 2001).

The bad news is the shortage of qualified teachers in mathematics classrooms. Though the number of high school mathematics teachers in U. S. public schools increased by 22,000 between 1990 and 2000 to a total of 134,000, the percentage of teachers who are assigned to teach high school mathematics classes who are certified to teach mathematics has decreased from 90% in 1990 to 86% in 2000. The situation is worse in middle schools. The number of middle school mathematics teachers has increased by 44,000 since 1994 to a total of 124,000 in 2000, but of teachers assigned to teach middle school mathematics in 2000, only 66% were certified to do so. Among the 50 states, only 11 have over 80% of their middle school mathematics teachers certified in mathematics (Blank & Langesen, 2001). The shortages for high-minority and low-income schools are particularly distressing. In schools with over 50% minority enrollment in grades 7-12, 24% of mathematics teachers teach out-of-field. For high-poverty schools where 60% or more of the students qualify for free or reduced-price lunch programs, 31% of mathematics teachers have neither an undergraduate or graduate major or minor in mathematics (Clewell & Forcier, 2001). Though state certification standards vary widely and some states do have higher percentages of their teachers certified to teach mathematics, the supply of qualified mathematics teachers remains inadequate nationwide. Indeed, 95% of urban school districts nationwide report an immediate need for high school mathematics teachers (Council of Great City Schools, 2000). The need to find qualified mathematics teachers for the nation's schools is critical.

Shortages in qualified mathematics teachers led the "Glenn Commission" (National Commission on Mathematics and Science Teaching for the 21st Century, 2000) to call for a significant increase in teachers as one of its three primary goals (p. 29). To achieve this goal, actions are needed both to identify exemplary teacher preparation models that can be widely replicated, and to attract larger numbers of qualified individuals into teaching mathematics.

Programs to Enlarge the Pool of Mathematics Teachers

A wide variety of strategies have been used to recruit and prepare qualified mathematics teachers, from offering summer undergraduate courses that promote teaching as a career (Della-Piana, Blake, Lopez, & Hurley, 2001) to recruiting mathematics teachers from Russia (Becker, 2000). Clewell and Forcier (2001) examined the range of recruitment programs and developed a continuum of outcomes for measuring program effectiveness. Following is a brief synopsis of their findings.

National Program

The Collaborative for Excellence in Teacher Preparation (CETP) created by the National Science Foundation is the only national program dedicated to the recruitment and development of mathematics and science teachers. This program supports a variety of activities to recruit teachers from nontraditional sources (i.e. paraprofessionals, mathematicians, scientists, and engineers who are seeking career changes), and particular attention is given to attracting prospective teachers from underrepresented groups. Of the more than 26,000 in CETP programs during 1998, 42% were minorities, and of those graduating, 50% were teaching in 1999.

State Programs

A few states have established policies that provide monetary incentives for individuals willing to teach subjects such as mathematics where there are teacher shortages (Clewell & Forcier, 2001), but there are no broad scale state programs specifically targeting mathematics teachers. The *Troops to Teachers* program is a mid-career transition, referral, and placement assistance program funded by the federal government, but administered through state support offices, and the U. S. Department of Education's *Teacher Recruitment Grants* support projects at the state level or partnerships between local education agencies and teacher preparation institutions. The funded projects target a variety of groups, including minorities; non-certified, mid-career degreed adults; certified reentrants; teacher aides; military personnel; *Teach for America* graduates; graduating college students with degrees in mathematics, science, or technology; undergraduates; and high school graduates living in high-need areas.

Local School District Programs

At the local level, individual schools districts have tried to tap nontraditional sources by targeting mid-career "switchers" and implementing alternative certification programs. Unfortunately, few nontraditional teacher recruitment and development programs collect and report evaluation data. In a study of programs in the past Kirby, Darling-Hammond, and Hudson (1989) found that graduates of alternative programs enter and remain in teaching in proportions comparable to those of graduates from traditional programs, and expressed interest in remaining

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in teaching are also comparable. Reviews of available data on more recent programs (Clewell & Forcier, 2001) indicate that current graduates are more likely to be minorities, and to be high achieving college students. Though most programs are modest in size and too new to provide reliable data on retention, early evidence suggests that some programs are exceeding yearly recruitment targets and the national average retention rate.

Steps to Take

Despite early signs that alternative programs and policies can contribute to an increased supply of qualified mathematics teachers, programs must be rapidly expanded and must address some issues particularly pertinent to recruitment of mathematics teachers (Clewell & Forcier, 2001). First, the labor market for individuals educated in mathematics has been increasing dramatically in recent years, yet the graduate pool has remained relatively constant. As a result, the level of competition for graduates will likely increase rather than decrease in upcoming years. This situation is exacerbated by the ongoing salary differential between teachers and other professionals with credentials in mathematics.

Second, research shows a positive relationship between student learning in mathematics and teacher preparation in content knowledge and teaching methods, so the current movement toward increased teacher preparation requirements will serve to reduce the already limited pool of prospective teachers.

Following are actions recommended by Clewell and Forcier (2001):

- Increasing monetary incentives to teach, including raising teacher salaries, providing scholarships, and forgiving loans of those who earn credentials to teach mathematics.
- Supporting development of partnership structures between universities and local schools and communities to target specific needs, share cost burdens of preparing teachers, and facilitate placement and ongoing professional development of teachers.
- Expanding the search for recruits among nontraditional sources, including mid-career "switchers", retired military personnel, undergraduates switching majors or those with undeclared majors, community college students with majors in math-related fields, and students who prepare for teaching but do not immediately enter the field.
- Pushing for greater evaluation and reporting of data on local programs that are successful in recruiting and preparing mathematics teachers.

Web Resources

Recruiting New Teachers, Inc.

http://www.rnt.org/

Offers publications on recruitment practices and preparation of teachers, a teacher recruitment clearinghouse, descriptions of alternative pathways to teaching, and links to other resources.

Troops-to-teachers

http://voled.doded.mil/dantes/ttt/

A program authorized by the No Child Left Behind Act of 2001.

Finding Resources in the ERIC Database

The best strategy for identifying useful resources is to use a combination of ERIC Descriptors and ERIC Identifiers to specify the content of interest. To find resources on teacher shortages, use the following Descriptors: "teacher supply and demand" or "teacher shortage". To find resources related to recruitment or alternative routes to certification, us the following Descriptors: "teacher recruitment" or "alternative routes to certification". You can restrict your search to mathematics teachers by using the following Descriptors: "mathematics teachers" or "mathematics education". To stipulate a particular grade range or level, use the following Descriptors: "elementary education", "intermediate grades", "middle schools", "secondary education", or "elementary secondary education". The following two Identifiers will lead you to alternative programs that have attracted qualified candidates into teaching: "AmeriCorps" or "Teach for America".

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